Claims

[c1] An electron beam lithography tool test pattern cell comprising: a first set of at least three elongated spaces, each elongated space having a different width than other elongated spaces in the first set.

[c2] The test pattern cell of claim 1, further comprising a second set of at least three elongated spaces, each elongated space having a different width than other elongated spaces in the second set.

[c3] The test pattern cell of claim 2, wherein the first set has substantially equivalent widths as the second set.

[c4] The test pattern cell of claim 2, wherein the first set and the second set extend from a border, and the first set is oriented orthogonally compared to the second set.

[c5] The test pattern cell of claim 2, wherein each set has elongated spaces with widths ranging from 100 nm to 1000 nm.

[c6] The test pattern cell of claim 1, further comprising at least one shape-in-shape pattern.

[c7] The test pattern cell of claim 6, wherein the at least one shape-in-shape pattern includes a first box-in-box pattern including elongated spaces that have a first width, and a

second box-in-box pattern including elongated spaces that have a second, different width.

[c8] The test pattern cell of claim 7, wherein each box-in-box pattern includes a cross blank pattern and an X blank pattern therein.

[c9] The test pattern cell of claim 1, wherein each elongated space is at least three spots long.

[c10] A lithography tool test pattern containing the test pattern cell of claim 1, wherein the test pattern cell is repeated at at least thirteen sub-field test positions of an exposure field.

[c11] A method of evaluating image quality of an electron beam lithography tool, the method comprising the steps of:
generating a test array of test pattern cell exposures at at least thirteen sub-field test positions in an exposure field, wherein each test pattern cell exposure within a given test array occurs under a different set of lithography tool test corrections; and
evaluating image quality based on the test arrays.

[c12] The method of claim 11, wherein each test pattern cell exposure has a corresponding exposure in each test array that occurs under the same set of lithography tool test corrections.

[c13] The method of claim 11, wherein the generating step includes:
repeatedly exposing the test pattern cell at each sub-field test position on a resist coated substrate;

shifting the resist coated substrate a predetermined distance between each exposure to generate the test array at each sub-field test position; and

developing the resist coated substrate to generate the test array at each sub-field test position.

[c14] The method of claim 13, wherein the step of shifting includes shifting in both a first direction and a second direction within a single plane.

[c15] The method of claim 11, wherein the evaluating step includes: determining which exposure within each test array provides a highest image quality and recording a test correction for that exposure for each sub-field test position.

[c16] The method of claim 15, further comprising the step of applying a tool correction for a selected sub-field position within the exposure field based on recorded test corrections for the sub-field test positions.

[c17] The method of claim 16, wherein the step of applying a tool correction includes:

implementing a two-dimensional, third-order polynomial equation for each recorded test correction;

calculating a set of correction coefficients for each two-dimensional, third-order polynomial equation; and

applying the set of correction coefficients to determine the tool

correction for the selected sub-field position.

[c18] The method of claim 11, wherein the evaluating step is conducted for at least one of a focus correction, an in-axis astigmatism correction, and an off-axis astigmatism correction.

[c19] The method of claim 11, wherein the test pattern cell includes:
a set of at least three elongated spaces, each elongated space having a different width than other elongated spaces in the set; and
at least one box-in-box pattern.

[c20] A computer program product comprising a computer useable medium having computer readable program code embodied therein for correcting a lithography tool, the program product comprising:
program code configured to determine a tool correction for a selected sub-field position within an exposure field based on recorded test corrections for at least thirteen sub-field test positions.

[c21] The computer program product of claim 20, wherein the determining program code:
implements a two-dimensional, third-order polynomial equation for each recorded test correction;
calculates a set of correction coefficients for each two-dimensional, third-order polynomial equation; and

applies the set of correction coefficients to determine the tool correction for the selected sub-field position.

[c22] A computer-readable storage medium having stored therein instructions for performing a method, the method comprising the steps of:
determining a lithography tool correction for a selected sub-field position within an exposure field of the lithography tool based on recorded test corrections for at least thirteen sub-field test positions including:
implementing a two-dimensional, third-order polynomial equation for each recorded test correction;
calculating a set of correction coefficients for each two-dimensional, third-order polynomial equation; and
applying the set of correction coefficients to determine the lithography tool correction for the selected sub-field position.

[c23] A system for optimizing lithography tool image quality, the system comprising:
means for determining a tool correction for a selected sub-field position within an exposure field of a lithography tool based on recorded test corrections for at least thirteen sub-field test positions, the determining means including:
means for implementing a two-dimensional, third-order polynomial equation for each recorded test correction;
means for calculating a set of correction coefficients for each

two-dimensional, third-order polynomial equation; and means for applying the set of correction coefficients to determine the tool correction for the selected sub-field position.